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CANTALOUPE PRODUCTION IN CALIFORNIA

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In 1905, only a few hundred carloads of cantaloupes were shipped from California; in 1925, 16,581 cars—well over half of the carlot shipments of cantaloupes for the whole United States—originated in this state. The cantaloupe industry in California today has a greater cash value than any other one truck crop in the state. The increasing centralization of the crop in the western states and the decreased production in the eastern part of the country have constantly pushed the center of cantaloupe production toward the west. This is because of the high quality of melons produced under western conditions. Here, low atmospheric humidity acts as a check to fungous diseases; absence of rain during the picking season favors the development of good flavor and of the firmness that is necessary for long shipment; and the continuous sunlight enables the plant to manufacture the maximum amount of carbohydrate, which is necessary for the high sugar content desired in melons.

Increasing population, improved transportation facilities, broader distribution, both seasonably and geographically, and increased consumption of California cantaloupes resulting from high quality and from national advertising campaigns carried on by growers and shippers, indicate that production of this crop will continue to increase.

This circular is prepared to give general suggestions on the culture and handling of the crop, especially for growers who lack experience in cantaloupe production under California conditions.

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CANTALOUPE DISTRICTS

Table 8 on page 42 gives data on production in the leading cantaloupe shipping states and figure 1 shows graphically the season of shipment in the more important districts. The important districts in California merit further discussion.

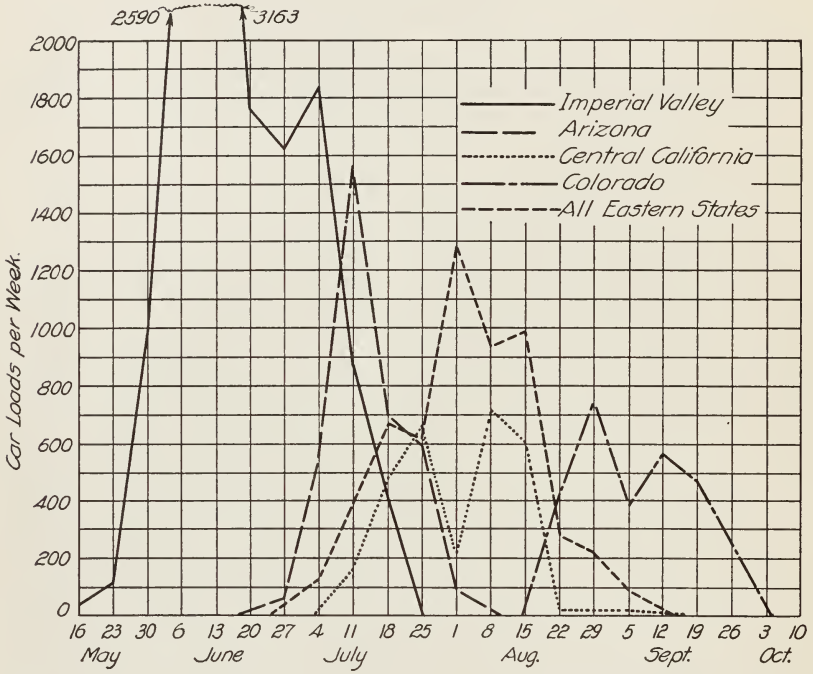

Fig. 1. Carlot shipments of cantaloupes from the principal shipping districts, by weeks, for the season of 1925.

Imperial Valley.—Three-quarters of the production for the whole state is in the Imperial Valley. About 30,000 acres are planted annually, with an average yield of slightly over half a carload to the acre. About half the acreage is "extra early," the seed being planted in December and January under the protection of paper caps. The remainder is planted without protection in February and March. Cantaloupes are grown entirely with surface irrigation in this district. Shipments normally begin about May 20 and continue until July 15, during which time Imperial Valley cantaloupes largely dominate the markets of the entire country. In the early part of the shipping season, Mexico, Texas, and Florida offer some competition. These sec-

tions are climatically suited to grow earlier melons than Imperial Valley, but they produce melons of inferior quality—a fact that is reflected in the much higher prices brought by Imperial Valley cantaloupes. During the latter part of the Imperial Valley season, competition comes from Arizona and central California, and in some years the shipments from the south Atlantic states become a serious factor in July.

Kern and Tulare Counties.—Located in the southern part of the San Joaquin Valley, Kern and Tulare counties are climatically suited for the production of cantaloupes of high quality. The shipping season comes in July, and the market outlet is limited by the greater volume of cantaloupes moving from Imperial Valley in the early part of the season, and from Turlock later.

Turlock District.—The Turlock district, in the northern part of the San Joaquin Valley, was one of the first districts of California to become noted for melon production, the sandy texture of the soil being particularly favorable for growing cantaloupes of high quality. The crop has been very generally grown here with natural sub-irrigation, though in some places drainage is lowering the water table to such an extent that surface irrigation is becoming necessary. Marketing opportunities are somewhat circumscribed by competition early in the season with districts in central and southern California, and later with the Yakima Valley in Washington, and with Nevada, Colorado, Arkansas, and some of the eastern states. Generally, the production of Casaba, Persian, and Honey Dew melons has been found more profitable than cantaloupes in this district, for there is no important competition with any other district in the production of these increasingly popular types. Extensive planting of the land with trees and vines has limited the area available for melons.

Sacramento Valley.—Cantaloupes have been grown successfully in the warmer part of the northern end of the Sacramento Valley. Though the season in this section is only slightly later than in the Turlock district, the market outlet for the crop seems to be somewhat more limited.

THE SEED

From one to two pounds of seed are required to the acre. Since the seed costs only from $1.00 to $1.50 a pound, this is an item of small expense in the production of the crop. Success depends largely on the quality of the seed, and there are several different aspects to the question of quality. Of paramount importance is the purity of the seed from the standpoint of variety. Market requirements rigidly

insist on fruit having certain characteristics; and such fruit cannot be produced unless the seed planted came from fruit having the desired qualities. Seeds that are of mixed varietal characteristics, or which come from stock not carefully selected for the highest standards attainable, produce a crop largely of unmarketable or inferior melons. As will be explained later, cross-pollination between adjacent plants is common in cantaloupes, producing many varietal mixtures. Since nine-tenths of the varieties grown in America have no commercial value, contamination by inferior or undesirable types is all too frequent. No doubt, saving one's own seed from selected plants is the best insurance for seed of known quality; few growers, however, know how to produce pure seed in this way, or have the equipment for handling and cleaning. Furthermore, every grower would have his own standards for selection and soon all uniformity in the leading market types would be lost. This would put a serious handicap on the successful packing and marketing of the product.

To be of good quality, seed must be viable, i.e., when planted under conditions suitable for germination, from 90 to 95 per cent of the seed should produce plants. However, lack of viability is seldom a problem with cantaloupe seeds, which retain germinating power for about ten years, if stored in a cool dry place. In the tropics, under conditions of high temperature and high humidity, the viability is quickly lost. Seed shipped to tropical countries, therefore, should be in air-tight containers or in waxed-paper packages. Some growers claim that seed three or more years old gives better results than new seed. Though there is no evidence to support the theory that old seed has any physiological superiority over new, there is one practical advantage from its use: seed which tests satisfactorily on a small scale one year may be used to plant the main crop in succeeding years.

There has been considerable discussion of the relative merits of seed grown in different sections of the country. There is little well-substantiated information concerning the effect of climate on the crop-producing power of any kind of seed. That climatic factors may be the direct cause of the deterioration or "running out" of a variety, is improbable. Lack of selection to maintain the varietal type may be more common with some growers than with others, however. The fact that corn seed from northern localities produces an earlier crop than southern grown seed is often cited to prove the general superiority of seed grown in the north; this superiority, however, is due to the effects of the natural selection exercised by the short growing season in the north, which causes the automatic elimination of the slower growing plants. That such effects are to

be expected in the cantaloupe to any marked extent is unlikely, because of the relative purity of cantaloupe varieties and the fact that cantaloupes are to a large extent self-pollinated.

In 1923, seed of a pure strain of the Salmon-tint variety were sent to different states where they were grown, seed saved, and returned to Davis, California, for testing the following year. No noteworthy differences were observable when these seeds from different sources were planted side by side at Davis. It was found, however, that the average weight of the seed grown in different sections differed considerably, as indicated by the number of seeds to a pound.

TABLE 1

Weight of Seed Grown in Different Sections

	Seeds to a pound
Original stock, grown in Colorado	14,480
Progeny grown in South Carolina	14,930
Progeny grown in Imperial Valley, California	16,850
Progeny grown in Riverside, California	17,310
Progeny grown in Maryland	23,733

The weight of seed may be affected by the maturity of the fruit when harvested. Furthermore, climatic conditions may play a part in seed weight, for where the fruit is caused to mature with extreme rapidity by high temperatures, or prematurely through defoliation of the plant by disease, the seed will be light. It is the experience of growers in the Turlock district that seed produced on a late crop, maturing in October, is heavier than that from an early crop, in which the melons ripen during the hot period of July and August. Accordingly, crops intended for seed are planted there in June or July, to get the benefit of maturation in the cooler season of the fall.

SEED PRODUCTION

At the present time, the market demand is chiefly for a type of cantaloupe that is round or slightly oval; of such size that the majority of the fruit will pack 45 to the standard crate; heavily netted all over and free of cracks, deep sutures and of depressed or protruding blossom ends, firm and solid, so that it will carry well; thick fleshed with small seed cavities, and with firm, fine textured flesh of the proper color for the variety; and of high sugar content and fine flavor. Uniformity in size, shape, and season of maturity is of great importance. A crop having a large proportion of melons of "jumbo" or "pony" sizes is undesirable. Earliness and disease resistance also have to be considered at times.

The cantaloupe plant bears two kinds of flowers, as shown in figure 2: staminate or male flowers, which are by far the most numerous, and hermaphroditic flowers, which contain both male and female organs, and are potentially self-fertile. Not all of the latter class of flowers produce fruit, however; those near the base of each branch set freely, resulting in the formation of a "crown set." Some fruits may form on the outer part of the branches later in the season. Bees are the chief means of pollination; the perfect or hermaphroditic flowers are seldom fertilized unless visited by a bee or other insect which scatters the pollen so that some of it falls on the stigma (female

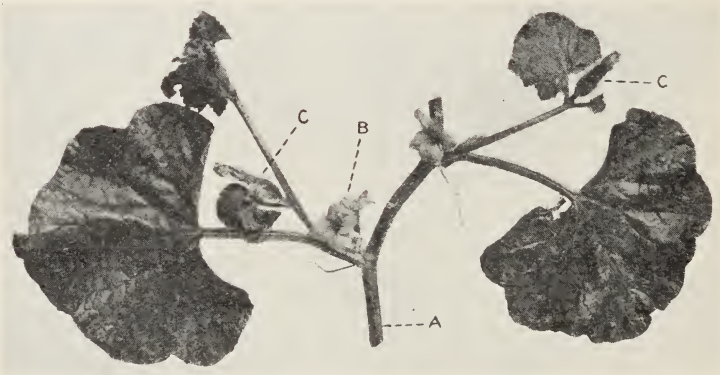

Fig. 2. Portion of cantaloupe stem showing (*a*) main stem, (*b*) staminate flowers, (*c*) hermaphroditic flowers, which produce the fruit.

organ). Hence bees are very desirable in the commercial melon field. Since they also carry pollen from flower to flower and from plant to plant, they are likely, however, to cause extensive cross-pollination, which, if different varieties are planted near by, leads to varietal mixtures. There is no immediate or apparent effect from such cross-pollination; only the seed have "hybrid" embryos, and when planted will give rise to a "hybrid" plant, having some of the characteristics of both parents. Inter-varietal crossing under controlled conditions is an important step in the production of new varieties; but from the seed-grower's point of view, chance crossing is undesirable. It is not known how far bees are likely to carry pollen. Probably the chances of crossing are very small when different varieties are planted a mile apart.

The cantaloupe crosses freely with the Persian, Honey Dew, Casaba, and Santa Claus melons. It does not cross with the cucumber,

watermelon, squash, or gherkin, which belong to different species, and furthermore, these crops do not affect the quality of cantaloupe seed or fruit when grown near by.

Even though the seed field is planted with the purest stock seed obtainable, and though it is reasonably well isolated from other varieties, it is necessary to practice a certain amount of roguing. Plants that produce undesirable or off-type fruits should be destroyed to prevent the inclusion of seed from such plants in the harvest. The average of all the fruits on the plant, and not the quality of any one fruit, should be the basis of consideration in selecting for

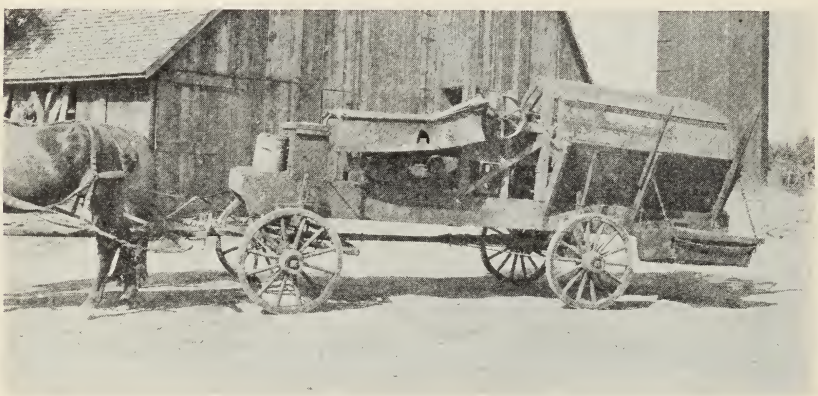

Fig. 3. Thresher used in harvesting melon seeds. The 2 h.p. gasoline engine which operates the crusher and the reel, is under the canvas at point marked A.

improved types. Fields intended for seed production are usually planted much thicker than the market crop; the extra number of plants will produce more fruit, with increased seed production. A good yield of seed is 800 pounds to the acre. The fruits are allowed to become fully ripe on the vines. Two to three pickings are usually made on seed cantaloupes. At each picking, the ripe melons are piled in windrows. A threshing machine, such as that shown in figure 3, is then driven through the field and the melons are pitched into the hopper of the grinder with forks. The rinds and much of the pulp are discharged on the ground. The juice and seeds are collected in barrels or tanks and left from two to five days to allow fermentation, which removes the gelatinous coating on the seed and facilitates separation of seed from pulp. Water is then added and the pulp floated off. The seeds are washed several times and are finally dried in thin layers on screens.

VARIETIES

The term "cantaloupe" is a mis-nomer. In the species *Cucumis melo,* there are several sub-groups which were classified and named by Charles Naudin, of France, about seventy years ago. The name *Cantaloupensis* was applied to a group of varieties having warty or furrowed fruit, while the varieties having a netted surface were included in the group *reticulatus.* The former group is extensively cultivated in Europe and is still called the cantaloupe melon there. Netted varieties grown in Europe are called "melon brodes." However, by common usage the term cantaloupe has come to be almost universally used for the netted varieties in America. The term "muskmelon" might be applied to any member of the species having a musky odor. The winter melons, such as Casaba and Honey Dew, belong to the group *inodoratus* (lacking odor).

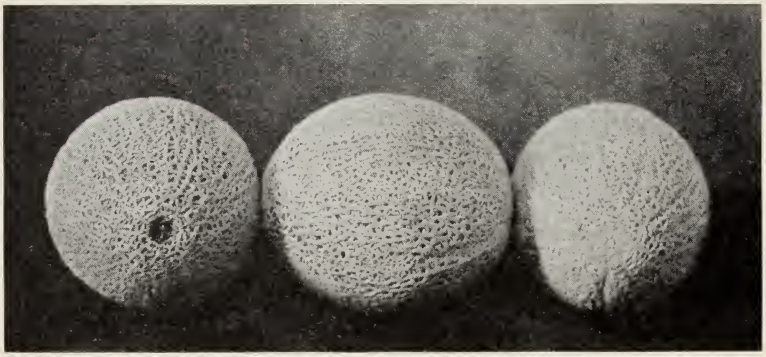

Fig. 4. Stem-end, side and blossom-end views of the Salmon-tint (Ten-Twenty-Five) variety.

Among the netted melons, there are a number of varietal types and a long list of varietal names, many of which are duplications. Only a few varieties are commercially important. Those most popular in California are described below.

The Pollock Group.—The fruits are small to medium in size; rounded oval, not ribbed, heavily netted; sutures absent or only a line, well netted over; season of maturity medium early. Green-fleshed varieties of this group are Eden Gem, Green-Meated Pollock, Early Watters, Netted Rock, Mission Bell, and Buskirk's Blight-Proof.

The pink-fleshed varieties (this color of flesh is sometimes referred to as orange or yellow) of this group are Golden Pollock, Gold Winner, and Netted Nugget. Partly yellow-fleshed varieties are Salmon-tint, Pollock or Ten-Twenty Five, Gold Lined Pollock, and Edward's

Perfecto. These have from one-third to one-half of the flesh next to the cavity colored pink when ripe. The Salmon-tint or Ten-Twenty Five variety has been used most largely, with a limited acreage in the green-fleshed varieties. The latter are supposed to be somewhat earlier, but are rapidly losing ground in commercial production. In the eastern and southern states the green-fleshed varieties are grown more extensively. The pink or yellow-fleshed varieties, while of splendid appearance and eating quality, are generally supposed to be poorly adapted for long shipment; commercial production of these varieties is rapidly increasing, however.

Fig. 5. The Hearts of Gold variety.

Hale's Best.—Hale's Best is a 1924 introduction, of the same general type as the Salmon-tint variety, but is said to be earlier in maturing. It has pink flesh, is well netted, and has become popular on the market. It is said to be the result of a chance cross between the salmon-tint and the Emerald Gem, originally selected by a Japanese grower in Imperial Valley, and subsequently developed by Mr. I. D. Hale. Some stocks of this variety are considerably mixed as to varietal type.

Hearts of Gold (Hoodoo).—This variety (fig. 5) has recently become popular in California. Its fruit is the same size as the Salmon-tint, but is ribbed with shallow longitudinal grooves or sutures, which are not netted over. The flesh is pink. The fruit matures somewhat later than the Salmon-tint.

Jenny Lind.—Although one of the oldest American varieties, this variety (fig. 6) is not grown extensively in California. The fruits are oblate, ribbed, well netted except in the sutures, and have a large stylar scar at the distal end. Some strains also have a protruding "navel" at the distal end. The flesh is pale green. The variety Fordhook is similar to Jenny Lind, except that the flesh is pink. The chief importance of these varieties lies in their extreme earliness in maturing.

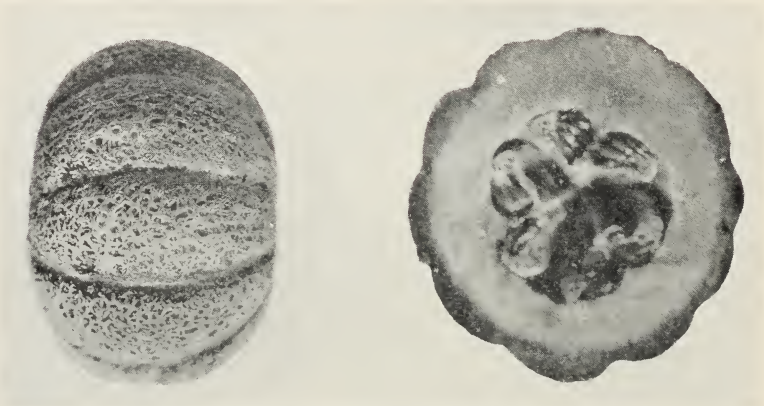

Fig. 6. Jenny Lind, a green-fleshed variety.

Fig. 7. Burrill's Gem, or "Pink Meat" variety.

Burrills Gem (Ordway Pink Meat, Pink Queen.)—Although important in Arizona and Colorado, this variety (fig. 7) has never become popular in California. The fruits are ovate or oblong, sparsely netted, ribbed, pink fleshed, late in maturing and somewhat subject to cracking. Since it does not pack so well in a standard crate as the more nearly round varieties, it is usually shipped in flats. On account of its luscious quality, it has brought higher prices on eastern markets than other varieties.

Tip-Top.—Though this is not a shipping melon, it is grown extensively for local markets in southern California. The fruit is larger than the varieties discussed above and is oval in shape (fig. 8); it is ribbed and has little or no netting; the flesh is pink, with a green layer next to the rind. Similar varieties are Irondequot, Surprise, and The Bender.

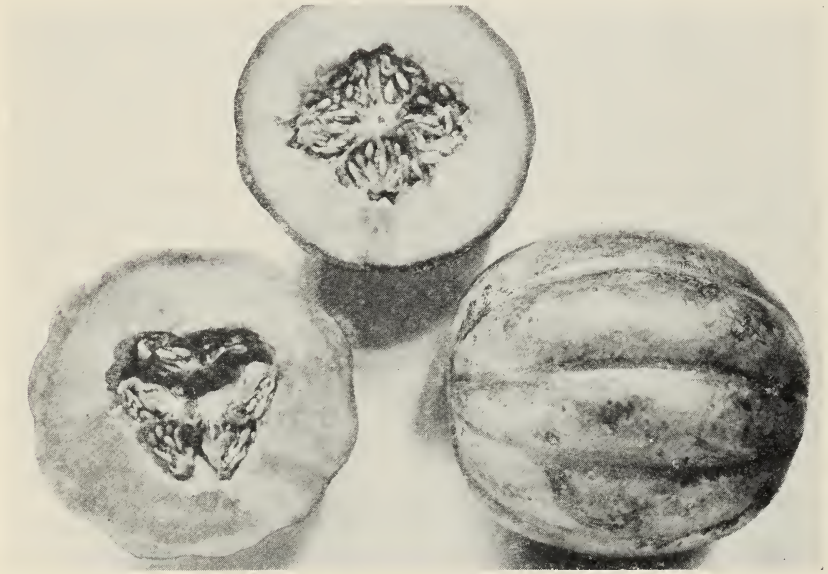

Fig. 8. Tip-Top variety. Fruit at left has 3 locules, the one above has 4.

Paul Rose.—The Paul Rose is grown for local markets in northern California. The fruit is small, oval, ribbed, heavily netted on the ribs, and has smooth sutures, and pink flesh.

Montreal.—This is one of the largest-fruited varieties, the melons often weighing 15 pounds. The fruit is round and sparsely netted, has shallow sutures and green flesh, and is late in maturing. It is popular for restaurant and hotel trade in late summer in southern California. J. M. Thurmon, Saticoy, California, has developed a pink-meated strain, earlier in maturing than the old Montreal.

OTHER TYPES OF MELONS

Mention should be made here of other important types which, although closely related to those varieties called cantaloupes, belong to other botanical sub-species.

Casaba.—The name Casaba, derived from the town of Kassabah, in Asia Minor, includes several distinct varieties, the first of which

is said to have been introduced in this country in 1868. Casabas are now grown extensively in California. Golden Beauty is the leading variety. The fruits are large, oblate, oval or pear shaped; lemon yellow in color, not netted or ribbed, but with numerous longitudinal corrugations or wrinkles; they have thick tough skin, and white flesh, are late maturing; and possess long-keeping qualities. Since the stem does not form an abscission zone upon maturity, as cantaloupes do, the proper stage for picking the fruit is determined by the softening of the blossom (stylar) end of the fruit. Generally, the fruits are marketed when they are too hard and immature to be of the best quality. After two or three months' storage at ordinary temperatures, the flesh becomes very soft and juicy. Another variety of Casaba is the Santa Claus melon, the fruit of which are long, cylindrical, smooth, and colored with splotches of black and yellow. In other respects, this variety is similar to Golden Beauty.

Honey Dew.—Honey Dew is similar to the French variety White Antibes. It was introduced into Colorado about 1913, thence into California, where it is extensively grown. Statements sometimes made that this melon is the result of a cross between a cantaloupe and a casaba are not founded on fact. The fruits are rather large, oval, and not ribbed or netted, with smooth white skin. The flesh is pale green. Since no abscission zone is formed upon maturity, the only guide in harvesting is the development of a yellowish tint and a softening at the blossom end. Although a fairly good keeper, this melon does not last so long in storage as the other winter melons. A variety having pale pink flesh was introduced in 1923 and is known as Golden Honey Dew.

Persian.—This melon was probably brought to California about 20 years ago by the Armenians. It seems to be exclusively a California product at present, and is generally considered to be of the highest quality from the consumer's point of view. The fruit is large, nearly round, sparsely netted, and not ribbed, and has very thick pink flesh. It requires a long growing season, and when it is left on the vine until fully mature, there is a partial development of an abscission zone, so that the fruit can be slipped from the stem. Generally the fruits are picked for market before this stage is reached, when the blossom end softens slightly and the color of the skin, seen between the netting, assumes a yellow or slightly red tint. While the Persian partakes somewhat of the firmness and long-keeping qualities of the Casaba, it is distinct from the latter, and is not generally considered adapted for long shipping. Hence the eastern markets have not been extensively supplied with this melon as yet. There is need for the

development of a strain having a strong blossom end, which is the main defect that handicaps the shipment of this variety at present. The culture of the Persian in the Imperial Valley has not been very successful, as the lateness in maturing exposes the plants to injury by the melon aphis. Armenian and Armenian Hybrid are other names for this variety. The Turkish melon is a variety having ribbed oblong fruits, but otherwise similar to the Persian. The California type of Persian is distinct from the variety of that name described in English and French literature.

SOIL AND CLIMATIC REQUIREMENTS

Muck or peat soils are never used for cantaloupes, and heavy clays and adobe soils are generally avoided. They are grown most extensively on sandy soils, as in the Turlock district, and on sandy loam and fine sandy loams in the Imperial Valley. In sections where early production is desirable, it is necessary to have a soil which warms up rapidly in the spring. This requires good drainage and a light open texture; heavier soils are better adapted to the later crops. Soils for growing cantaloupes should have a good supply of organic matter and should be in at least a fair state of fertility.

In selecting land for cantaloupes, the grower should ascertain that it is free from nematodes, and from toxic amounts of alkali. Old alfalfa land is considered best for cantaloupes.

The cantaloupe requires a growing season free from frost; warm nights with hot days induce best development. The plants are easily killed by frost at any stage, and comparatively high temperatures are required for both germination and subsequent growth. On the Pacific Coast, cantaloupe culture is generally limited to the warm interior valleys.

Relation of Climate to Quality.—Atmospheric conditions are important in several ways. Low relative humidity of the air during the fruit-ripening season favors the development of the thick coarse netting and solidity of flesh, both of which are very important for good shipping quality—ability to stand rough handling, long shipment and delay in reaching the consumer. Low humidity, coupled with lack of rain and dew, holds in check fungous diseases which weaken or destroy the foliage of the plants in humid sections unless careful spraying is practiced. Because of freedom from diseases, western cantaloupes generally yield well; have a long picking season; the melons have a better flavor, and a higher sugar content than those grown in the eastern states.

FERTILIZERS

The majority of the soils in the arid interior valleys of California are particularly low in organic matter and hence are lacking in nitrogen, but in nearly all cases other essential plant-food elements, including phosphorous and potassium, are present in relatively large amounts. Where no attention has been paid to supplying organic matter to the soils, potassium and phosphorous may be in such a form that they cannot be utilized by plants. On the other hand, soils that are rich in humus rarely need additional supplies of chemical nitrogen, phosphorous or potash for successful cantaloupe production. It is the common practice of cantaloupe growers to use land that has been in alfalfa for a number of years. Profitable crops of cantaloupes can usually be grown at least one year and sometimes longer after plowing up the alfalfa without additional fertilization. However, on land not previously in alfalfa, or prior to the second and third crops of cantaloupes after alfalfa, the plowing under of 10 to 20 tons of barnyard manure to the acre will often be found profitable. In sections of the state where early cantaloupes are produced, a summer cover crop of cowpeas can be grown after the harvesting of the melons. In Imperial Valley, Brabbam, Victor or Iron cowpeas have not only given larger yields of green material than other summer legumes, but these varieties are also resistant to nematodes. In turning under a cover crop, the material should first be well mixed with the soil by double discing and should then be plowed under, and the land irrigated to promote rapid decay of the organic matter.

In some sections of the state, especially on light soils, increased yields have been secured by using chemical fertilizers. Little definite information exists as to the elements that may be profitably used, however, and only careful local tests can determine the proper fertilization practice. A common practice is to use a complete fertilizer containing nitrogen, phosphorous and potash. This no doubt is usually wasteful because it is very likely only one element is really needed. As a rule, one application of 400 to 600 pounds to the acre is made, just prior to planting. Comparative tests in California and elsewhere indicate, however, that a second application made just prior to the time the plant begins to send out branches more than justifies the additional cost.

Better results have been obtained by applying the commercial fertilizer in a furrow than by broadcasting it over the entire surface of the ground. The fertilizer may be spread by hand or drilled in

with a corn and cotton planter fitted with a fertilizer attachment or with a special fertilizer drill, when the beds are being made. When walking plows are used in bedding, the fertilizer is applied in next to the last furrow on the south side of the bed. The fertilizer is covered by the last furrow slice which makes up the bed. When bedding is done with a tractor drawing a set of six plows, a large can is set on the plow frame just ahead of the plow which throws up the last slice on the side of the bed. The fertilizer is fed from this can through an adjustable opening. When a second application is made at the time the plants are starting runners, the fertilizer may be applied with a drill which is drawn about half way between the plant and the bottom of the irrigation furrow, or else a hillside plow may be used to open a furrow near the plants, in which the fertilizer is scattered by hand or with a drill, and a lister then used to throw the soil over the fertilizer and to open up the furrow for irrigation.

CULTURAL PRACTICES

Planting Date.—The time of planting has become fairly well established in different sections. The average planting date for a given locality varies somewhat from year to year, as weather conditions, especially temperature, determine the optimum date. Generally, a large part of the crop is planted somewhat earlier than the optimum date, in order to obtain the advantage of the early market, if unfavorable weather does not destroy the crop. A temperature above 50° F is required for germination of melon seeds. If the soil is cooler than this, the seeds decay or germinate so slowly that they are destroyed by wire worms or corn maggots. The planting date is regulated to some extent to mature the crop at a time when market conditions are likely to be favorable. Table 2 shows approximate planting dates for different sections.

TABLE 2

APPROXIMATE PLANTING DATES FOR VARIOUS CANTALOUPE SECTIONS

Imperial Valley, Calif.	Dec. 15–Apr. 1	Dover, Del.	Apr. 5–20
Turlock, Calif.	Mar. 15–Apr. 15	Anna, Ill.	Apr. 5–15
Tulare, Calif.	Mar. 1–Apr. 1	Yakima, Wash.	Apr. 20–May 1
Sacramento Valley, Calif.	Apr. 15–May 15	Medford, Ore.	Apr. 10–May 1
Brownsville, Texas	Feb. 10–20	Rocky Ford, Colo.	May 1–June 1
Blackville, S. Car.	Apr. 1–15	Grand Rapids, Mich.	May 20
Bolton, Ark.	Apr. 1–20	Moapa, Nev.	Apr. 1–15
Glendale, Ariz.	Apr. 1–20	Decker, Ind.	Apr. 1 (in hotbed)

Preparation of the Soil for Planting.—When alfalfa sod is used, it should be plowed the preceding summer. To kill out the alfalfa roots, a shallow plowing may be given first, followed by a double discing. In about two weeks the ground is replowed, this time to a depth of six or eight inches, and is usually left lying rough, though some growers prefer to disc right after the plowing, thereby facilitating later operations. The land is allowed to lie idle as long as possible and is then bordered up and a heavy flood irrigation given (fig. 9). The borders are knocked down, the land double disced and smoothed down with a large float. The ground is then ready for planting, or for bedding where planting is done on raised beds.

When cantaloupes follow cantaloupes or other summer truck crops, the beds of the previous crop are first disced down, the land plowed six to eight inches deep, and smoothed with a float. About a month before planting time, the land is irrigated and fitted as described in the preceding paragraph. When cantaloupes follow lettuce or other winter truck crops, the beds of the previous crops are double disced so that the ground is flat, (fig. 9) and, since the soil is generally quite moist, beds for the cantaloupes are thrown up without further treatment.

Various methods are employed in making beds for cantaloupes (figs. 10, 11), some growers preferring walking plows, others using a two-bottom riding plow drawn by a small tractor, while others use a large caterpillar tractor pulling six plows and making two half beds at a single operation.

The beds are marked out with a riding lister, to which a marker disc is attached (fig. 10). The lister makes a furrow eight to ten inches deep. The beds are formed by back-furrowing, making three rounds with ten-, twelve-, or fourteen-inch walking plows. The tops of the beds are then harrowed with a two-section spike-tooth harrow. Some growers prefer to use a disc, which packs the tops of the beds better. The south or west sides of the beds are than smoothed off with a V. A twelve- or fourteen-inch lister is then run in the dead furrow, between the beds, to clean it out and to give as high a bed as possible. The seed is then planted and the ground irrigated.

Some growers prefer to irrigate prior to planting, especially if the land was not pre-irrigated before bedding. This is done after the tops of the beds have been harrowed. As soon as the ground is dry enough, the beds are disced, the south or west side firmed and smoothed down with a V, and the seed planted.

Fig. 9. Preparation of land for cantaloupes.

Top—Disking up the winter crop of lettuce.
Center—Flooding, after leveling and bordering the land.
Bottom—Smoothing and leveling just before bedding.

Fig. 10. Preparation of beds for cantaloupes.

Top—The first operation, marking off the rows, seven feet apart.
Center—Forming the bed by back furrowing over the lister mark.
Bottom—The bed is completed except for breaking out the dead furrow.

Fig. 11. Preparation of cantaloupe beds.

Top—Forming sides of two beds with tractor-drawn "bedding machine."
Center—Harrowing down the beds. Necessary only where the soil is cloddy.
Bottom—Smoothing the south or west side of bed with a V.

While a few growers use low beds, the great majority favor high beds facing south or west. A larger surface exposed to the sun means that the soil will warm up more quickly, the plants will be more protected from winds, and the vines and melons will be kept out of the water in the irrigation furrows.

In the Turlock district, melons are often grown without irrigation on land with a high water table. Here no beds are used, the seed being drilled in rows the proper distance apart, on the level surface of the soil. In other sections, where only a small amount of irrigation is necessary, the seed is planted on level ground and furrows are made between the rows for irrigation when necessary.

Method of Planting.—There are three general methods of planting cantaloupe seed: by hand, the seed being covered with a hoe; by hand planter; and by drilling in the seed, either with a hand or a horse-drawn seed drill.

When planting by hand, a hoe with a handle about fifteen inches long is used (fig. 12 above). The soil is deeply cultivated with this hoe for about ten or twelve inches around the "hill" where the seed is to be placed. A hole about six inches long, four inches wide, and about an inch or two deep is then made with the hoe, and into this are dropped from four to fifteen seeds, depending upon several factors which will be discussed later. The seeds are not bunched but are spread around in the hole. The soil is then firmed over the seed and a little loose soil placed on top to provide a mulch. Only about one pound of seed to the acre is sown by this method. Where cheap labor must be depended on, this is usually the favorite method of planting.

Where a somewhat better class of labor can be obtained, hand planters or "jabbers" (fig. 12) are used. Two modifications are necessary for these planters. One consists of setting a cone in the interior so as to spread the seed, and thus prevent the bunching of the seed in the hill; the other, of attaching a shoe to the outside to prevent the planter from being pushed too deeply into the ground. With these two attachments, hand planters are finding much favor. Without the cone in the interior, the twelve or more seeds dropped each time come up in a bunch resulting in rather weak spindling plants, which are difficult to thin without seriously interfering with the plants to be left. This method is considerably cheaper than planting with hoes, one man being able to plant at least eight acres a day with a planter as against about an acre a day with a hoe. Very little more seed is used.

Late plantings, which are not to be protected with hot caps, are sown with hand drills or one-horse planters. Some growers attach

a hand drill behind the V that is used to shape the south side of the bed, as shown in the top of figure 13. Other growers prefer to do the two operations separately and use horse-drawn planters (fig. 13). Planting with drills has certain advantages. If a responsible man can

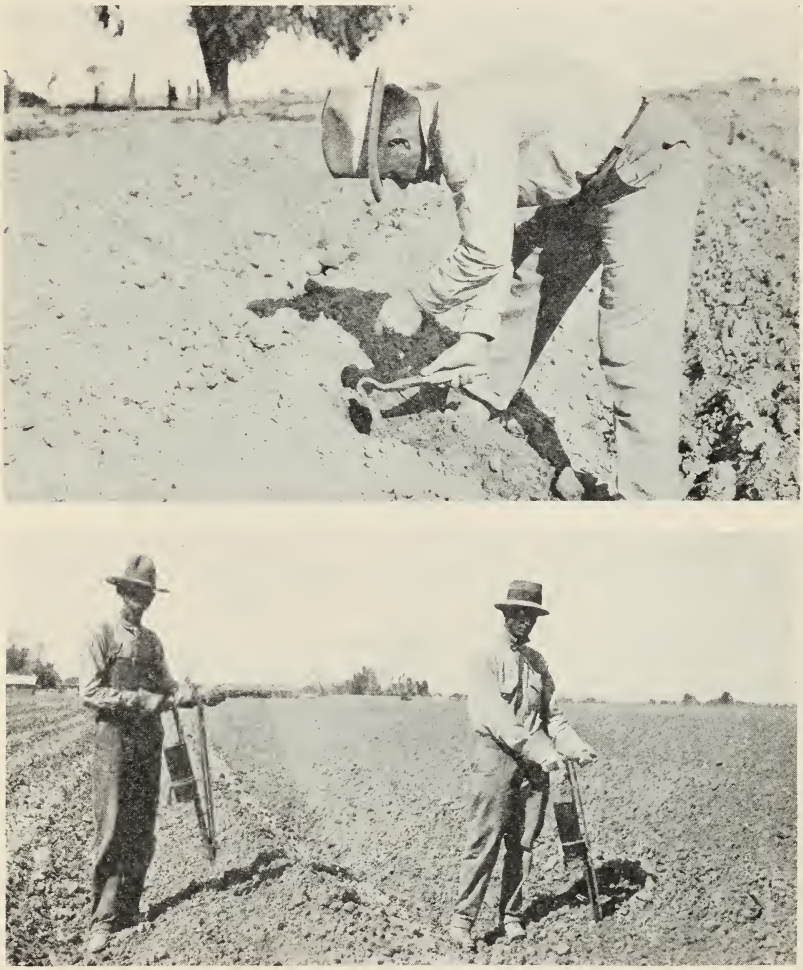

Fig. 12. Planting cantaloupes by hand.
Above—With short-handled hoe. Below—With hand planter.

be obtained who will make certain that the planter feeds regularly, little difficulty should be experienced in getting a one hundred per cent stand. The drill puts all the seed down at a uniform depth and with uniform packing on top, and the seeds are spaced evenly along the bed. If the operator is careless, however, the drill may become

clogged and an uneven stand result. Planting with a drill is far more rapid than planting by hand with a hoe. An excess of seed is sown in machine planting, to insure a uniform stand.

The depth of planting varies from one-half to one and one-half inches, depending on the type and condition of the soil and the season of the year. Late season plantings, light sandy soils and soils not well pulverized require deeper planting.

Fig. 13. Planting cantaloupes with seed drills. Above—Seeder hitched behind the V used in smoothing the bed. Below—Two seeders drawn by mules.

Spacing.—In the Imperial Valley, practically all of the beds are seven feet apart. A few growers use six-foot beds. The "hills" are four to four and a half feet apart if the plants are to be covered with paper caps for frost protection. Two plants are left in each hill. For late plantings, which are not protected, single plants are left eighteen to twenty-four inches apart. The plants are generally thinned twice, double the necessary number being left at the first

thinning. Replanting of missing hills should be done at the time of the first thinning.

While growers usually follow the spacings mentioned above, this sometimes may be varied to advantage. Spacing is an indirect method of regulating the size of the fruit. With varieties whose tendency to produce fruits too large, and where growing conditions are very favorable, more marketable fruits can be produced by closer planting.

Fig. 14. Cantaloupes protected with glassine paper covers. Large cantaloupe fields are laid off in sections 400 feet long, with ditches and roads across the field to facilitate distribution of water and the hauling out of the fruit.

Forcing Earliness.—Where earliness is a matter of primary importance, several methods of hastening maturity may be useful. In the Imperial Valley, the young plants are frequently protected with paper covers. Plants so protected mature their crops four to ten days earlier than unprotected plants. These protectors also make it possible to plant early, during December and January, and so provide a better distribution of labor. Several kinds of paper covers are in use. Most common are glassine or wax paper covers, sixteen by eighteen inches in size. Nearly all growers prefer the glassine paper (fig. 14) as it does not seem to hold condensed moisture so late in the morning, and less burning of the plants occurs with this type of paper. In recent tests,[1] conducted at the Michigan State College, it was found that glassine paper allowed a much higher percentage of light to go through than did parchment or oiled paper, that the temperatures were higher under the glassine and that tomato plants made a more vigorous growth under the glassine than under other types of paper.

[1] Hibbard, R. P. Frost protectors for early planting. Michigan Agr. Exp. Exp. Sta. Quarterly Bul. 7:150–153. 1925.

The covers are put on immediately after planting. To support them a piece of No. 17 galvanized iron wire eighteen to twenty-four inches long is bent to form an arch, the ends being thrust into the ground so as to form an inverted U-shaped arch about four inches high in the middle, and running parallel with the direction of the bed. The paper cover is then placed over this arch and the edges covered with soil to hold it in place. One man can put on from five hundred to twelve hundred caps a day, the larger number being possible only where the soil is light or well pulverized. Galvanized iron wire is used for the arches because it will not rust and can be used for several years.

Fig. 15. Thinning and hoeing cantaloupes planted under protectors, the paper having been temporarily removed for this operation.

When the plants are about an inch high, the covers are removed, the plants thinned, and the ground around the plants cultivated with a hoe, as shown in figure 15. The paper cover is then replaced unless it has been badly torn, in which case a new one is put on. After the early part of March the side of the cap away from the prevailing wind is left up (fig. 16) to allow more air and light to get to the plant, and so harden it before the covers are removed entirely. At this time some growers replace the sixteen by eighteen inch papers with larger ones, twenty by twenty-four inches, using two wires at right angles for supports. These larger caps are used partially for forcing but mainly for protection from wind. About April 1, when

all danger of frost is deemed passed, the paper caps are removed and burned, and the wires taken up and stored for use the next year.

During the past three years brush and paper windbreaks (fig. 17) to shield the plants and blossoms from wind have been used in the Imperial Valley, in addition to the paper caps. These are conducive to a further increase of several days in earliness. Before the paper caps have been removed, a brush and paper shelter is made to protect each hill. Some growers have these protectors running along the top of the bed in a straight line, the tops of the brush leaning somewhat over the plants. The best practice, however, is to have each protector so constructed that it runs diagonally up the bed. This gives each plant more protection from the wind and allows more space for training the vine over the bed. To make the protectors, four to eight sticks of brush spaced four to six inches apart are thrust into the ground. The tops of the sticks are inclined forward over the plants. Two double sheets of newspaper are then placed against the brush sticks. Four to eight more sticks are then placed behind, and soil is hoed over the base of the paper to keep it in place. The cultivation costs are somewhat increased, but since this system prevents the wind from whipping off the crown set of blossoms and from damaging the leaves, the extra protection afforded is said to be worth the additional costs.

Another device for protecting early planted melons consists of a machine-pressed paraffined paper cone, which is rigid enough to support itself, although it has to be anchored with soil banked on a flange around the base of the cone. These caps can be put in place more rapidly than other protectors, but are not considered so efficient. Experiments with other kinds of large paper caps are now being made by growers to find some method of reducing the expense of the brush protectors as windbreaks.

Transplanting.—When a hotbed or greenhouse is used to start the plants, the seed is sown about one month earlier than the field-planting date. As the cantaloupe is not easily transplanted, the seeds are sown directly in containers, whence the plants are transferred to the field without disturbing the root system. Four-inch clay pots, paper pots or veneer dirt-bands are used. Transplanting, which has to be performed with great care, is not done until warm weather prevails. Much extra expense is involved in growing the plants and in transplanting them to the field, yet the practice appears to be profitable in certain sections.

Other factors conducive to early maturity of the crop are selection of early varieties or strains, general good cultural conditions, pro-

tection from cold winds with shelter belts of grain or hedges across the field, selection of fields having a slight slope toward the south, and good drainage.

Fig. 16. Cantaloupe plant growing under paper cover, one end of which has been removed to harden the plants before the cover is finally removed.

Fig. 17. This illustrates the construction of the brush and paper wind-breaks, which slope over the young melon plants, and greatly increase the early growth.

Cultivation.—A large, deep root system is essential to vigorous vine growth and satisfactory yields of cantaloupes of high quality. Deep cultivation early in the season aerates and warms the soil, thereby stimulating root activity, and puts the soil in condition to take up moisture. Cultivation also kills weeds which compete with the cantaloupe plants for moisture and plant food. However, excessive cultivation to create a fine mulch to conserve moisture is useless and merely adds to the cost of production without compensating results.

As soon as possible after the first irrigation after planting, the bottoms of the furrows are cultivated with a seven-tooth one-horse walking cultivator (fig. 18). This is from fifteen to thirty days after planting, according to the rapidity with which the soil dries out. The tops of the beds may be cultivated at this time, using the same cultivator with the teeth spread out. Some growers only give one cultivation between the first and second irrigation, while others cultivate three or four times. After the last cultivation, a lister is run through the furrow or the rear cultivator tooth is replaced with a wing shovel, to clean out and deepen the furrow preparatory to

Fig. 18. The one-horse cultivator is used to keep the soil in good condition between irrigations. Here the paper covers have just been removed, but no brush wind-break provided.

the next irrigation. Usually one cultivation of the furrow is given after each irrigation, until the plants are so large that further cultivations will damage them. The number of times the bottoms of the furrows are cultivated varies from four to eight. The tops of the beds are cultivated two or three times (fig. 19).

Later cultivations are always more shallow than the earlier ones, because of the small feeder roots which have been formed near the surface of the ground. Most growers gradually shift the irrigation furrow further and further from the plant at each irrigation, the purpose being to allow more space for roots to form along the south side of the bed. After the final cultivation, a large sixteen-inch lister is used, or else a fourteen-inch lister with the adjustable wings spread out. This leaves a deep wide furrow for the irrigations during harvest.

Fig. 19. The horse-cultivator may be used crossways of the beds when the planting is in hills. This saves an expensive hand hoeing.

Hoeing is expensive and is never done unless considered essential. The ground around the plants is usually hoed from two to four times, according to the date of planting, condition of the ground, and amount of weed growth. If there is any tendency for alkali to accumulate, this is scraped away from the plants when the hoeing is done. Light hoeing is usually given when the plants are thinned (fig. 20).

Fig. 20. Hoeing and thinning late cantaloupes which were planted with a seed drill.

The plants are small then, with roots near the surface, so the hoeing must not be done deeply. Weeds near the plants are scraped off, and a fine mulch created around the plants. This is usually done with a short-handled hoe. A second hoeing is often necessary between the hills at the time the cultivation between irrigations is given. Usually one more hoeing is given with the long-handled hoes, this one being deep and thorough to kill the weeds and create a mulch around the plants and between the hills.

Fig. 21. The vines are trained across the raised beds and should be kept out of the irrigation furrow as long as possible.

Turning the Vines.—If irrigation is practiced, it is important to keep not only the melons but also the leaves out of the water in the irrigation furrows. Cantaloupes that lie on wet ground have a smooth, pale colored spot on the ground side. It is necessary, therefore, to train the vines out of the furrows (fig. 21). This is done two or three times during the season simply by lifting the long runners that have gone down into the furrow, and placing them on the bed.

IRRIGATION

In nearly all of the cantaloupe growing districts of California, irrigation is necessary, and in the hot interior valleys where most of the melons are grown it requires especially careful attention. Both quality and quantity of production may be injured by insufficient irrigation. Ripening can be hastened by withholding water, but usually at the expense of yield and quality.

The water requirements of the cantaloupe plant depend mainly on the size of the plant and the weather conditions. Large plants use correspondingly more water than do small ones. Since the leaves evaporate more water in warm, dry, or windy weather, plants should be given more water under such conditions than in cool or humid weather. The water requirements differ therefore not only for each locality in the state, but also from season to season, from month to month, and from week to week. The irrigation practice used in the interior valleys would be unsuited to the cool, moist coastal regions. The capacity of the soil to retain water is an important factor in determining the frequency of irrigation. It is therefore only possible to give general, and not specific, recommendations regarding irrigation practice.

If the cantaloupes are grown on raised beds, it is the practice to have the soil moist before the beds are thrown up. This may have been done by flooding the soil before preparing the beds, or else it may have resulted from the irrigation of some previous crop, such as lettuce or peas. This preliminary irrigation is very desirable. After the beds are thrown up, some growers apply a heavy irrigation, the water being held in the furrows until the beds are soaked through. As soon as the land is dry enough, the tops of the beds are cultivated, and the seed planted. Most growers, however, plant their seed first and then irrigate, running a small stream of water down the furrows until the water has soaked up the beds to just above the seed drill line, or, in case the plants are covered, to an inch or two above the upper edge of the paper cap. It is important that the water in the furrows should not reach within three or four inches of the plants.

After this first irrigation, it is advisable to wait as long as possible before applying more water. This will vary from ten to sixty days, according to the soil and the weather. Delaying the second irrigation is considered important in order to allow the young plants to develop a deep root system. Another consideration in withholding this irrigation as long as possible, is to allow the soil to warm up. To judge when to give the second irrigation after planting, the condition of the soil and of the plant must be taken into consideration. The soil under the surface mulch should be examined, and if it is dry, an irrigation is needed. A few of the small plants can be pulled up to examine the condition of the roots. Some growers irrigate when the soil dries out to the point where it will not cling to the roots when the plants are pulled up. Plants needing water appear droopy, have a dark green color, and the edges of the leaves curl inward. In the Imperial Valley, for early plantings the second irrigation is given just after the paper caps are removed.

As a rule, the next irrigation is delayed until the buds of the first hermophroditic flowers appear. It is important not to have extreme moisture fluctuations during the time the "crown" set is forming, as such fluctuations may cause a failure to set fruit.

A fourth irrigation is usually given when the first of the second set of melons have attained the size of walnuts. One more irrigation may be given prior to the beginning of the harvest, depending on conditions.

During the harvest period the weather is very warm, and the plants are large and have an enormous leaf area which is evaporating moisture, hence plenty of water should be given. However, the irrigations should be light, to avoid water-logging the deeper layers of the soil. When the ends of the runners droop and have a dull appearance, and the leaves show a decided tendency to curl up the plants are likely to be suffering for water. Experienced irrigators can tell by the way the leaves at the ends of the runners stand up, and by the light green color and thrifty vigorous appearance of the vines that the plants are not in need of water.

Frequency of irrigations during harvest will depend on the weather, the size of the plants, the character of the soil and the judgment of the grower. In the Imperial Valley some growers irrigate every other day throughout the harvest season, while others irrigate every third day for the first ten days or two weeks and then every other day. On the other hand, in relatively cool weather and with heavy soils, irrigations eight to twelve days apart may be sufficient.

DETERMINATION OF MATURITY

Determination of the proper stage of maturity for picking cantaloupes intended for shipment has proved a difficult problem. The object should be to pick each melon at that stage of its development when it has attained good eating quality and when it at the same time has sufficient firmness to stand shipment. To a certain extent, these qualities are opposed, for the highest quality is generally attained when the fruit is fully ripened on the vine, but this stage of development is accompanied by softening, and further changes result in melons which are "over-ripe" by the time they reach the market. Various rules may be formulated for the guidance of the pickers, but no one of them will hold good universally. Difference in varieties, time of season and weather conditions must always be considered, as well as the distance which the melons are to be shipped.

External Signs of Maturity.—(1) Netting. The corky suberized tissue known as netting should be fully developed all over the fruit. It should also be well raised above the skin, and rounded out at the surface. In immature fruit the netting is flat and shows a slight line or crease along the top and can be easily rubbed off with the finger. The net on a mature melon is hard (2) Color of skin. Little of the skin is visible in the heavy-netted types. Change of color from dark green or grey-green to yellowish is indicative of maturity. (3) Condition of the stem. Considerable emphasis has been laid upon this as a guide in picking. In most varieties, as ripening advances, a crack develops around the stem where it joins the fruit. When maturation is complete, the stem slips cleanly from the fruit, which is then known as a "full slip." No other guide is needed in picking fully ripened melons for the local market, though complications arise in picking melons at the proper stage for shipment.

Extensive experiments made in 1916 and 1917 by the United States Department of Agriculture[2] on shipments of Pollock cantaloupes from the Imperial Valley and Turlock, California, to New York show how important proper maturity is to good quality.

TABLE 3

Results of Picking Cantaloupes at Various Stages of Maturity on Shipments from Imperial Valley and Turlock to New York, 1916 and 1917 (after McKay, Fischer & Nelson)

	Too soft *Per cent*	Too yellow *Per cent*	Decayed *Per cent*	Im-palatable *Per cent*	Total defects *Per cent*
Condition on unloading:					
Picked commercially	13.4	6.1	.3	.....	.....
Picked at full slip	12.7	11.5	.1	.....	.....
Picked just before full slip	9.7	2.2	.1	.....	.....
Condition two days later:					
Picked commercially	20.7	14.9	5.1	13.9	54.6
Picked at full slip	17.7	27.0	3.1	.1	47.9
Picked just before full slip	11.6	10.7	.4	1.9	24.6

The condition of the melons two days after removal from the refrigerator cars in New York indicates that the commercially-picked melons contained many which were picked too green. Table 3 indicates that full-slip melons were somewhat too soft and too yellow for

[2] McKay, A. W., G. L. Fischer, and A. E. Nelson. The handling and transportation of western cantaloupes. U. S. Dept. Agr. Farmers' Bul. **1145**: 1–20. 1921.

the most part, while those picked just before full slip had the least percentage of defects. It was further found that the early or "crown-set" melons can be safely left on the vine until the full-slip stage, while later in the season ripening proceeds so rapidly that picking at a stage somewhat preceding the full slip is necessary.

Internal Changes During Maturation.—An important feature of the ripening process is the increase in sugar content, especially sucrose, as the fruit matures. Fruit picked when immature has a low sugar content, which cannot be increased after it is removed from the plant. While immature fruits may soften somewhat during shipment and so seem to become riper, the sugar content is still low and the flavor poor.

The chemical changes accompanying maturation, and the correlation between composition and external indications of maturity, have been studied by Chase, Church, and Denny.[3] Since edible quality depends on texture, flavor, and sweetness, and as texture and flavor cannot be measured conveniently, they took sugar content as the index of maturity.

They found that the condition of the stem was not an absolutely dependable indication of maturity, for often half-slip melons were of better quality than those picked at the full slip, and sometimes full-slip fruits were too immature for human consumption. Although the color of the skin becomes lighter upon maturity, attempts to classify melons on this basis were unsuccessful, for a third of the melons having dark green skins had the composition of mature melons. Moreover, while there was some correlation between maturity and disappearance of the "water-line" (the crease on top of the net), still it was found that 50 per cent of melons showing a distinct line on the net were ripe enough to ship. Concerning the development of the netting, they found that only 65 per cent of the fruit having well-developed netting were of satisfactory ripeness, while 26 per cent of melons having only a poorly developed net had satisfactory sugar content.

Since none of the external indications of maturity were found to have an absolute correlation with edible quality, Chase, Church, and Denny set out to find a more exact index whereby this factor could be judged. They reported that the refractive index of the juice, percentage of soluble solids as determined with the Brix spindle, total sugar content and sucrose content, gave excellent correlations

[3] Chase, E. M., C. G. Church, and F. E. Denny. Relation between the composition of California cantaloupes and their commercial maturity. U. S. Dept. Agr., Dept. Bul. 1250: 1–26. 1924.

with edibility. Table 4 is summarized from their data, which were obtained by examination of a large number of cantaloupes grown in the three leading districts of California, in 1920.

As a result of their investigations, Chase, Church and Denny concluded that cantaloupes having a Brix reading (percentage of soluble solids) of 10 or more could almost certainly be considered of marketable quality; 9 to 10, doubtful, and below 9, unsuitable for marketing.

TABLE 4

Relation of Eating Quality of Cantaloupes to Composition of the Juice

	High quality	Satisfactory	Doubtful	Not marketable
Tulare:				
Brix, degrees	12.0	11.0	10.0	7.9
Sucrose, per cent	6.58	5.29	4.13	2.04
Turlock:				
Brix, degrees	11.6	11.0	9.1	7.7
Sucrose, per cent	6.12	5.39	3.55	1.77
Brawley:				
Brix, degrees	12.3	11.9	10.0	8.6
Sucrose, per cent	.....	.....	.....	.....

Note.—Brix degrees are roughly equivalent to per cent of soluble solids.

The percentage of soluble solids in the extracted juice depends largely on the sugar content. Since the soluble solids can be determined roughly in the field with the Brix spindle, it is a convenient index of sugar content and of maturity. Shippers often make the mistake of assuming that the percentage of soluble solids of the juice is the same as the sugar content of the whole fruit. However, the relation between them is constant enough to make the former a useful guide.

From what has been said above, it is evidently difficult to correlate physical appearance with composition. However, experience under a given set of conditions checked against a few determinations of soluble-solids content from day to day, enables one to pick melons that will ship well and will be of good quality, with a considerable degree of certainty. The method of determining soluble solids is as follows: Several representative melons are cut and their seeds and placentae removed. The edible portion is spooned out and passed through a food chopper or is well mashed. The juice is squeezed out through cheese-cloth, placed in a tall cylinder, and allowed to stand five minutes. Then a spindle hydrometer, graduated in degrees

Brix, is placed in the juice, the top reading taken and corrected for temperature.

The principal result of the work of Chase, Church and Denny has been to fix a standard by which the maturity of any given lot of melons can be actually determined and which can be used as evidence to justify the condemning of melons that were evidently too immature ever to be fit for human consumption.

Fig. 22. Picking cantaloupes in the Imperial Valley. Each man picks one row and empties his sack at the end of each 400-foot section. Note type of picking sacks and field crates.

Changes of Composition in Transit and in Storage.—There is a general idea among growers and shippers that cantaloupes picked and shipped in an immature condition will ripen during transit. To test this point, Chase, Church and Denny placed lots of cantaloupes of uniform maturity in cold storage for periods equal to those for transit from California to eastern cities—from 10 to 14 days. Analyses before storage, upon removal therefrom, and two days after removal, showed that there was little change in composition and that two days after removal there was a loss of one per cent in sugar content. There was, however, some improvement in flavor because of the softening of the fruit.

PICKING, PACKING AND SHIPPING

During the height of the picking season, the field should be gone over every day. Picking should be done between sunrise and 8 A.M., gathering the fruits while they are cool and turgid.

Cantaloupes must be handled carefully throughout the journey from field to table. Bruising leads to decay, and the consequent poor market quality of many cantaloupes. For picking, a canvas sack slung from the shoulders, and open at both ends is preferred. Such a sack is not likely to be dragged on the ground by the picker, and is convenient to empty into the field crates (fig. 22) for hauling to the packing shed. Hauling the fruits from the field in large sacks or loose in a wagon box causes much bruising. At the packing shed, the melons should go into padded bins, whence they are passed, in grading, to the canvas-bottomed packing tables.

The importance of careful handling is brought out by table 5, which records data obtained in 1917 on 20 shipments of cantaloupes from Turlock, California, to New York.[4]

TABLE 5

Spoilage of Cantaloupes Resulting from Careless Handling

	Decayed *Per cent*	Molded *Per cent*	Bruised *Per cent*	Total spoilage *Per cent*
Condition on unloading:				
Carefully handled	0	0.5	.....	.....
Commercially handled	0.5	2.4	.....	.....
Condition two days later:				
Carefully handled	0.4	0.3	3.5	4.2
Commercially handled	6.0	9.2	11.7	26.9

Successful handling involves many precautions such as being careful not to drop or drag the picking sacks on the ground, not to over-fill the field crates, not to drop or roll the melons when emptying them into the packing bin, and not to squeeze over-sized melons into crates when packing. It is important that the melons be packed and loaded into the refrigerator cars as quickly as possible, since deterioration is rapid under high temperature conditions.

Grading.—While no standard grades for cantaloupes exist, the fruit should be graded for uniformity in size, maturity, and appearance. Careful shippers discard all cracked, bruised, diseased, ill-shaped, over-ripe, and immature fruits, as well as the "slickers" which are not well netted at the blossom end, and those which are noticeably soft. The ripe melons are kept separate and shipped to points near by.

[4] McKay, A. W., G. L. Fischer, and A. E. Nelson. The handling and transportation of western cantaloupes. U. S. Dept. Agr. Farmers' Bul. **1145**: 1–20. 1921.

Practically the only grades considered in buying and selling cantaloupes are those associated with size. These are designated by the style of crate and number of fruits contained, as Pony 54's, Standards 45's, 36's, 27's, and Jumbo 45's, and 36's. Uniformity of size is important in putting up an attractive, snug pack which will ship and sell well.

Fig. 23.—Interior of large cantaloupe packing shed showing the receiving side. On the left the melons are being unloaded from the trucks which hauled them from the field. In the center are the graders and opposite them are the packers.

Shipping Packages.—Gradually the styles and sizes of packages are becoming standardized.

1. The "standard" crate generally holds 45 melons packed in three tiers of 15 each; sometimes, however, it contains 36 in three tiers of 12 each, or 27 in three tiers of 9 each, according to size of fruit. The inside dimensions are 12″ x 12″ x22″. It consists of two paneled heads 12 in. square, and 12 slats (three to each side) which are 23½″ x 3″ x ⅜″.

2. The "Jumbo" crate is 13″ x 13″ x 22″ inside measurements, and is similar to the standard in construction. It holds 36 or 45 melons, somewhat larger than standards.

3. The "Pony" crate is 11″ x 11″ x 22″ inside measurements, and is similar to the standard in construction. It holds 45 or 54 melons, smaller than standards.

4. The "Standard Flat" crate is 4½″ x 13″ x 22″ inside measurements. In it are usually packed 12 or 15 melons, in a single tier, as shown in figure 25.

Crates are generally bought from the lumber mills as "shook," the parts being cut to proper size and the heads already put together. These crates are made up as needed, using cement coated nails which are less likely to pull out.

Packing.—The packing shed should be near the field and should be provided with ample shade or a double roof. It should be arranged so that the melons are unloaded in the field crates on one side of the shed, whence they are emptied by the grader into the grading bins. The grader removes all defective melons, dropping them into crates on the ground, while the melons to be packed are placed, according to size and maturity, in bins on the opposite side of the table (fig. 23). The packers work on the side of the table opposite the graders; when the crates are packed, they are placed on a conveyor which takes them to the lidder (fig. 24).

Fig. 24.—Interior view of large cantaloupe packing shed, showing the out-going side. At the left are the packers and the conveyor which takes the packed crates to the lidder. In the center are stacks of packed crates, lidded and ready to be loaded. On the right are the refrigerator cars into which the crates are loaded almost as soon as they are packed.

The average field packing shed to handle 80 acres of cantaloupes requires 2 or 3 men to empty the field crates and do the grading, 4 or 5 packers, one man to nail the covers on, and one loader.

In packing, the melons are placed end to end in regular rows, and are selected in size, so as just to fill the crate at the sides and ends, with a slight bulge on top. The "Pink Meat" or Burrill Gem type of cantaloupe, being oblong in shape, is packed in a slanting position instead of end to end.

Wrapping.—The use of individual tissue paper wraps has been general, especially for the "Pink Meat" type. It is claimed that wrapped cantaloupes do not soften so rapidly if delayed in loading,

or after unloading from refrigerator cars, that shrinkage due to loss of water is checked, and bruising of the fruit is lessened. However, wrapped melons do not cool off as rapidly in refrigerator cars as those not wrapped. Upon unloading, the paper retains moisture

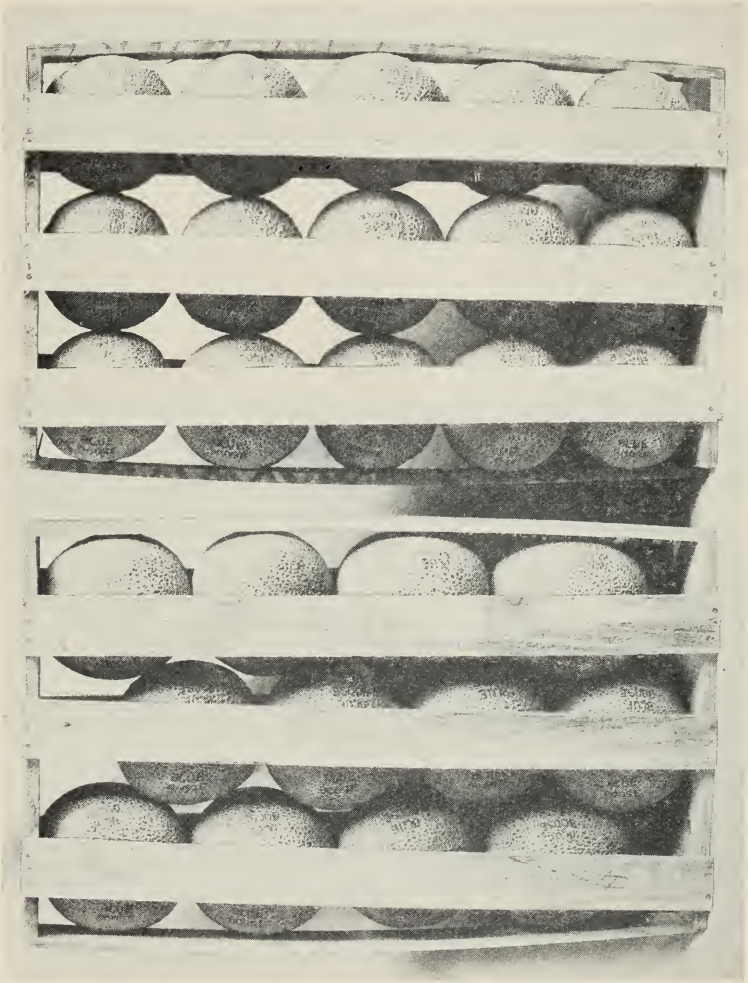

Fig. 25. Cantaloupes packed in flats. Above—15 "standard" melons to the crate. Below—12 "Jumbo" melons. Note the trademark "Blue Goose" stamped on the individual fruits.

which condenses on the surface of the cool melons and promotes molding and decay. Wrapping is also undesirable because it discourages inspection and encourages the shipment of defective stock. The most common practice at present is to wrap only the fruits placed in the middle layer in the crate, which are most exposed to bruising.

The effects of wrapping are shown by the following results obtained in 13 experimental shipments from Imperial Valley to New York in 1916, reported by McKay, et al.[5]

TABLE 6

Relation of Wrapping Cantaloupe Fruits, to Spoilage

	Too soft *Per cent*	Too yellow *Per cent*	Decayed *Per cent*	Molded *Per cent*
Condition on unloading:				
Wrapped	17.7	8.7	0.5	3.1
Not wrapped	15.3	4.6	0	0.2
Condition two days later:				
Wrapped	28.8	17.7	28.7	42.4
Not wrapped	34.0	12.5	4.6	2.7

Fig. 26. Loading flats into refrigerator car. Note floor racks, method of stripping and bracing, and loaders' tally board.

Loading.—For long shipments, pre-cooled refrigerator cars are used; these may be re-iced several times during transit.

An average car-load consists of 320 standard crates or 800 flats. Promptness in loading is essential, for softening proceeds very rapidly at the high temperature usually prevailing at the shipping point. The effect of delayed loading on quality is shown by the following

[5] *Op. cit.*

results of McKay et al., experimental shipments from Imperial Valley to New York, which were delayed one, four, and eight hours at shipping point, before loading.[6]

TABLE 7

Effect of Delayed Loading on Spoilage of Cantaloupes

	Too soft *Per cent*	Too yellow *Per cent*	Decayed *Per cent*
Condition on unloading:			
Loaded 1 hour after packing	8.4	8.4	0
Loaded 4 hours after packing	16.7	16.3	0
Loaded 8 hours after packing	27.0	15.0	1.2
Condition two days later:			
Loaded 1 hour after packing	30.6	20.9	2.9
Loaded 4 hours after packing	34.7	21.5	3.3
Loaded 8 hours after packing	43.2	26.3	4.4

Precooling.—Quick cooling of cantaloupes loaded in a warm climate for distant shipment is important. It has been found that warm melons loaded into a pre-iced refrigerator car are not cooled to 40° F until nearly three days after loading. At this temperature, however, the enzymatic and other chemical changes associated with softening or ripening proceed at a very slow rate, although they do not entirely cease. The use of various precooling systems has been advocated, to bring the melons quickly to refrigerator temperature, before loading, thus checking the softening process which otherwise goes on more or less rapidly for two or three days. Precooling, however, has not yet been extensively applied to cantaloupes.

MARKETING

The normal channel of distribution is from the grower to the carlot broker or distributing agency, which is often represented at the shipping point by the "cash buyer." During transit or after arrival at destination, the car is sold to a wholesaler, commission merchant, or jobber. The latter disposes of the melons to retailers in lots of from one to several crates.

Shipping Seasons.—Table 8 shows the usual range of the shipping season for the chief cantaloupe growing districts, together with the carlot shipments of the period 1921–25. The steady increase in production indicates that the markets of the country are increasing their absorption of cantaloupes.

[6] *Op. Cit.*

TABLE 8

PRINCIPLE CANTALOUPE SHIPPING DISTRICTS, SHOWING THEIR USUAL SHIPPING SEASON AND VOLUME OF SHIPMENTS

District	Shipping season	Carlots shipped				
		1921	1922	1923	1924	1925†
Texas	May 10–Sept. 1	162	186	367	416	469
Imperial Valley	May 20–July 20	10,708	12,243	12,165	15,757	13,410
Georgia	June 10–July 15	640	1,630	209	586	117
Tulare, Calif.	July 1–Aug. 20	244	550	511	*	*
Arizona	July 1–30	1,474	1,566	1,171	1,864	3,057
Arkansas	July 10–Aug. 15	1,501	990	329	1,052	1,063
North Carolina	July 10–Aug. 15	519	700	567	401	546
Indiana	July 20–Sept. 1	644	894	649	822	1,088
Turlock, Calif.	July 15–Oct. 15	2,156	2,439	2,589	2,535	3,176
Delaware	July 25–Sept. 1	943	843	827	511	637
Maryland	July 25–Sept. 1	1,204	1,233	1,200	699	1,084
New Mexico	July 25–Sept. 1	421	275	334	518	632
Rocky Ford, Colo.	Aug. 15–Oct. 15	3,151	4,420	2,314	2,654	3,050
Michigan	Aug. 10–Sept. 20	176	465	296	114	142

* Included with Turlock as "Central California" in the weekly summaries of carlot shipments, Bureau of Agricultural Economics, U. S. Dept. of Agriculture.

† The 1925 shipments do not include "Miscellaneous Melons" as Casabas, Honey Dews and Persians, while the data for the earlier years includes these under cantaloupes.

It is interesting to note that the season of shipments varies considerably, so that not all of the producing sections compete at the same time. Figure 1 has been constructed from the car-lot shipment records for 1925, to show the sequence of peak shipments from different sections. The Imperial Valley has a great advantage in that the bulk of its crop is moved before there is serious competition from other sections. The Salt River Valley of Arizona has a short season, with a peak movement following that of Imperial Valley. For central California, the first peak in the curve results from heavy shipments from Kern and Tulare counties, the second high point comes somewhat later with the movement from the Turlock district. The chances for profitable marketing of Turlock cantaloupes depends upon their maturing before the Colorado crop comes on, without overlapping to any great extent the Imperial Valley and Arizona seasons.

FACTORS AFFECTING PRICE AND CONSUMPTION

Distribution and daily carlot receipts on the larger city markets have a great influence on prices. Proper distribution from the main shipping sections to the various markets of the country has been

facilitated by the Market News Service of the United States Department of Agriculture. This has tended to eliminate over-supplying certain markets and under-supplying others.

Condition and Quality of Receipts.—Prices and consumption are depressed by large quantities of green, over-ripe, or diseased fruit on the market. Melons of poor quality sell at considerably lower prices or are unsaleable.

Source of Supply.—Western melons usually sell on eastern markets at higher prices than southern or locally grown melons, because of their high eating quality, their uniform pack, and their good keeping qualities. Cantaloupes received from humid regions fluctuate in quality from week to week, depending upon rainfall.

Volume of the Crops.—While acreage in the various sections fluctuates from year to year, the volume of shipments fluctuates still more, depending upon weather conditions. An over-supplied market lowers prices and has the indirect effect of causing much good stock to become stale before it can be sold, thus further depressing the market. Holding cars on the tracks for several days after their arrival at destination because of unsatisfactory prices causes deterioration in quality and demoralizes the market.

The prevailing weather in the large consuming centers has a marked effect upon consumption and therefore upon prices. Cool or rainy weather limits consumption, while fair and warm weather stimulates it.

Quality, Price, and Volume of Competing Crops.—Such fruits as cantaloupes, grapefruit, table grapes, and peaches are used largely for the same purposes; therefore, an over-supply of one results in lower prices and in a decreased demand for the others. Cantaloupe markets tend to be strong when the southern and eastern peach crop is shortened by spring frosts. Competition with Florida grapefruit is an especially important factor.

Market Preferences as to Variety, Size of Fruit, Type of Crate.—Figure 27 shows the relation of size or type of crate to wholesale price on the Chicago market in 1922. As a rule, prices on flats (multiplied by 3) are higher than for any other type of package. However, it is more expensive to pack and ship cantaloupes in flats than in standards. Thus, in 1923, the cost of one standard crate, including packing, at Turlock, California, was 40 cents, while the cost of 3 flats, including packing, was 66 cents. Freight charges also are somewhat higher on flats, since the railroad tariffs schedule flats at 28 pounds each, and standards at 68 pounds. It seems, however, that more extensive use of the flat crate would be justified, especially as it is

well adapted for a retail unit. For the size of melons packing 36 to a standard crate, use of flats seems especially advisable. As Pony crates sell at lower prices than standards, to ship this size after the early part of the season does not pay.

In spite of the general demand for rather small-sized cantaloupes, "Jumbos" bring higher prices than standards. In many cases, no doubt, the use of selected strains or of cultural methods that will produce a higher proportion of fruit of jumbo size will be profitable.

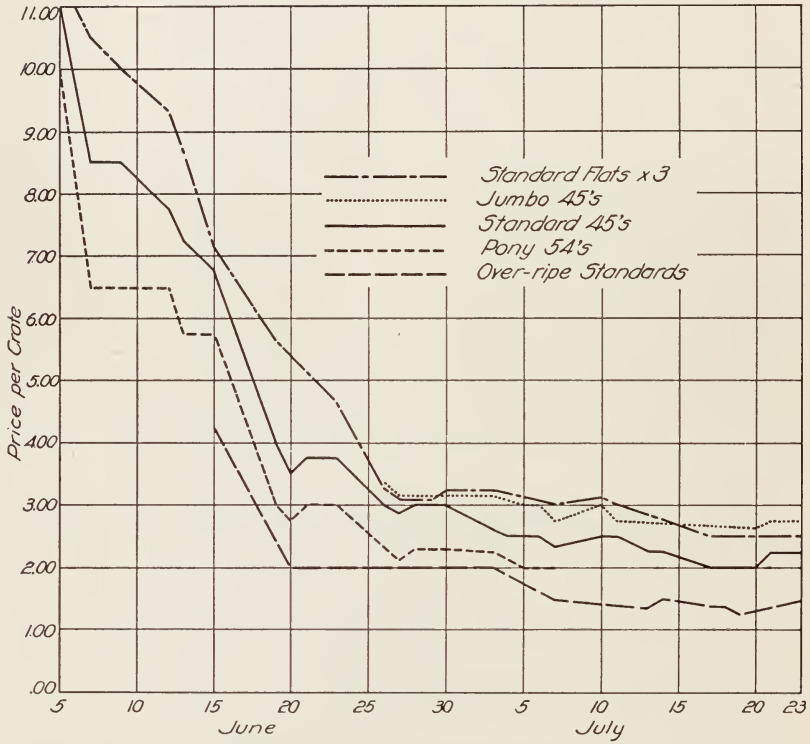

Fig. 27. Jobbing price per crate for different packs of Imperial Valley cantaloupes on the Chicago market in 1922.

The lower price of green-fleshed melons as compared with Salmon-tint types has been mentioned. The "Pink Meat" type (Burrill's Gem and Hearts of Gold) generally commands higher prices than any other type. The former variety, however, is comparatively late in maturing, does not have high shipping quality and is not adapted to culture in every section. The latter has proven quite satisfactory as a commercial variety in Imperial Valley and the Turlock districts.

INSECTS

Melon Aphis (*Aphis Gossypii*).—The melon aphis attacks all kinds of melons and many other plants. Its occurrence on cantaloupes is rather sporadic, but on account of rapid reproduction, it is frequently a cause of severe damage to melons planted late. Growers should always be prepared to control this insect as soon as it appears. If the early centers of infestation are allowed to spread, control becomes almost hopeless.

Fig. 28. A hand duster is shown here mounted on mule-back to facilitate the dusting for aphis.

The insect is a small green plant-louse, found chiefly on the under sides of the leaves, especially near the tips of the runners. After a time the leaves become curled downward, plant growth checked, and the plant itself killed. Nicotine dusts, applied with a hand or power duster (fig. 28) have been found effective against melon aphis. Commercial or home-made preparations containing two per cent nicotine sulphate (equivalent to 5 per cent Black Leaf Forty) are suitable for control of this aphis. If the presence of the aphis is noticed before many plants are attacked, some growers prefer to pour kerosene on and burn the infested vines.

Cucumber Beetles (*Diabrotica spp.*).—Two forms occur in California, one having spotted wings and the other striped. They are sluggishly flying insects, about $\frac{3}{16}$ inch long, yellowish green and black in color. While they feed on many plants, cantaloupes are one of their favorite hosts. The tender leaves of the young plants are particularly susceptible, whereas older plants do not seem to be much injured unless the insects are very numerous. The young fruits are

also attacked, with the result that they may be much scarred upon maturity. Cucumber beetles are relatively hard to control. Nicotine dust containing four per cent nicotine sulphate (10 per cent Black Leaf Forty) is fairly effective, as is calcium cyanide dust. When the plants are small, a cage covered with cheese-cloth, and large enough to cover the plants of a single hill, should be used in dusting. The cage is dropped over the plants to prevent the escape of the insects, and the dust is blown in through a hole in the side of the cage. Spraying and dusting with arsenicals, such as arsenate of lead, has been recommended in the eastern states for these insects, but has not proved successful in California. The Ohio Experiment Station[7] strongly recommends the use of a dust, consisting of one part calcium arsenate to 20 parts of gypsum. According to the same authority, lime should not be used in dusts applied to melons.

Cutworms.—Considerable damage to the young plants is caused by various species of cutworms, especially when cantaloupes are grown after alfalfa or sod. Many growers use no protective measures, simply resorting to replanting. Very successful results have been obtained, however, by using poison bran mash. The following formula and directions for mixing are recommended: Bran 25 pounds, paris green or white arsenic 1 pound, molasses 2 quarts, and water 3½ gallons. The amounts should be carefully measured and not guessed at. The paris green or white arsenic should be dissolved in 2 quarts of water to which the molasses is added and well mixed. This is thoroughly stirred into the balance of the water. Then slowly pour this liquid over the bran so as to get every particle of bran saturated. The bran should be moist enough so that only two or three drops of moisture can be squeezed out of it. The mixture should be distributed late in the afternoon as cutworms work mostly at night. About 7 pounds will be needed to an acre, scattering a small amount around each hill. J. C. Elmore, Junior Entomologist of the United States Department of Agriculture, in working in Imperial Valley found that attractants such as amyl acetate (banana oil), oranges, and lemons were of no value, and that the addition of more than 1 pound of poison to 25 pounds of bran made the bait distasteful to cutworms.

Red Spider.—Red spider causes injury to the leaves of the young plants very similar to the damage done by thrips. Spraying with 10 gallons of atomic sulfur to 100 gallons of water has given satisfactory control in Imperial Valley without any burning of the plants by the sulfur. Dry sulfur alone or in combination with lime will burn

[7] Houser, J. S., and W. V. Balduf. The striped cucumber beetle. Ohio Agric. Exp. Sta. Bul. 388: 241–364. 1925.

the young plants if the day temperature exceeds about 70 degrees Fahrenheit.

Seed Corn Maggot and Wireworms.—Seed corn maggot and wireworms sometimes attack cantaloupe seeds that have been planted in cold moist soil and have been slow in germinating. Sometimes the seedlings are attacked. Replanting when the ground is warmer seems to be the best treatment.

Nematodes.—Cantaloupes and all related crops are very susceptible to injury by nematodes. The injury, which is more likely to be severe on sandy soils, is known as "root rot" in Imperial Valley. Soil known to be infested should not be planted to cantaloupes. Fairly satisfactory control of nematodes has been effected by drilling in calcium cyanide at the rate of 600 pounds to the acre, and satisfactory crops of tomatoes have been grown after this treatment, but it is not known how cantaloupes would react to it.

DISEASES

Many of the fungous diseases, so destructive to cantaloupes in humid regions, fortunately do not occur to any extent in California. The absence of rain and the low humidity of the air during the growing season act as excellent preventives for most diseases of the foliage. At least two diseases of the foliage may attack cantaloupes in California, however.

Rust.—A disease of the foliage commonly called "rust" is caused by the fungus *Macrosporium cucumerium,* small circular water-soaked spots which enlarge and become tan-colored, appear on the leaves. It has been reported to be the cause of extensive damage to cantaloupes in Arizona. It was for resistance to this disease that the Salmon-tint variety was bred by P. K. Blinn; presumably attacks of the rust are not to be feared where this variety is grown. Since the fungus overwinters in the dead plants as dried mycelium, according to Brisley,[8] rotation of crops is advisable where this disease occurs.

Powdery Mildew.—In 1925 a very serious outbreak of powdery mildew, supposedly caused by a species of *Erysiphe,* occurred in the Imperial Valley, and caused a reduction of about fifteen per cent[9] of the crop, some growers suffering much more severely than others.

[8] Brisley, H. R. Blight of cucurbits caused by Macrosporium cucumerium. Phytopath. 13: 199–204. 1923.

[9] Ivan C. Jaggers, Pathologist, U. S. Dept. of Agriculture. Personal communication.

In 1926, mildew caused even more extensive damage in the Imperial Valley. It is possible that the unusually high humidity of the 1925 and 1926 seasons was responsible for the severity of the disease. The mildew appeared first in fields just before harvest, tiny grey patches (fig. 29) appearing on the under sides of the larger older leaves and quickly spreading to the younger small leaves and stems. The leaves and stems soon became dry and brittle, dying in from two to three weeks after the disease started on the vine. Tests were conducted in an effort to control the disease, though not until after the mildew became apparent on the leaves. Of all the materials tried, sulfur

Fig. 29. The whitish spots on cantaloupe leaves, typical of Powdery Mildew in the early stages of the disease.

alone appeared to control the mildew, but even when diluted seventy-five per cent with gypsum or lime, it caused such severe burning to the cantaloupe leaves that its use was abandoned. The following materials, applied three times at weekly intervals proved of no value: copper carbonate dust containing sixty-one per cent copper oxide; fifteen per cent monohydrated copper sulphate and lime; twenty-five per cent monohydrated copper sulphate and lime; ten per cent permanganate of potash; and twenty-five per cent copper carbonate. Dustings were made with crank type and bellows type hand dusters, with the most powerful engine driven power dusters on the market, and with airplanes. Applications varying from ten to seventy-five pounds to the acre were made. In 1926, all American varieties and many foreign varieties were tested at Brawley, California, and none of commercial value showed any marked resistance to mildew.

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